

**KNIGHTVILLE DAM
HUNTINGTON, MASSACHUSETTS**

**FOREST MANAGEMENT PLAN
MASTER PLAN APPENDIX B**

AND

**FISH AND WILDLIFE MANAGEMENT PLAN
MASTER PLAN APPENDIX D**

**Department of the Army
New England Division, Corps of Engineers
Operations Division
Waltham, Massachusetts**

May 1981

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL
NEDOD-P

SUBJECT
Master Plans, Appendices B & D, Forest and Fish and Wildlife
Management Plan, Knightville Dam

TO	FROM	DATE	CMT 1
See Distribution	Chief, Operations Division	16 July 1981 Mr. Mitchell/bp/305	

1. The subject appendices, prepared in accordance with ER 1130-2-400, dated May 1971, has been approved by the Division Engineer.
2. The plan has been developed to increase the value of reservoir lands for recreation and wildlife, and to promote natural ecological conditions by following accepted conservation practices.
3. This plan has been developed in coordination with the U.S. Fish and Wildlife Service, and the Massachusetts Divisions of Forests and Parks; and Fisheries and Wildlife.

Incl
as


ANDRELIUNAS

Distribution:

- (2) CDR USACE (DAEN-CWO-N)
WASH D C 20314
- (15) Operations Division, NED
- (1) Planning Division, NED
- (1) Engineering Division, NED
- (1) Real Estate Division, NED
- (5) Basin Manager, LCRB
- (5) Project Manager, Knightville Dam
- (5) Massachusetts Executive Office
of Environmental Affairs

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NEDOD-P	Master Plan Appendices B and D, Forest and Fish and Wildlife Management Plan, Knightville Dam

TO Commander FROM Chief, Operations Division DATE 8 June 1981 CMT 1
Mitchell/crs/305

1. Inclosed for your approval is the Forest and Fish and Wildlife Management Plan for Knightville Dam. This plan will serve as Appendices B and D to the Master Plan for this project.
2. It has been prepared in conjunction with ER 1130-2-400, dated 28 May 1971. It has been reviewed by NED Planning, Engineering and Real Estate Divisions; and the Massachusetts Executive Office of Environmental Affairs, the Massachusetts Division of Forest and Parks; and Fish and Wildlife. Appropriate changes have been incorporated.
3. Division Engineers have been designated as approval authority for these plans by ER 1130-2-400. Information copies are to be forwarded to OCE upon approval.

Incl
as



ANDRELIUNAS

CF:
Operations Div File

TO: Chief, Operations Division FROM: Commander DATE: 12 Jun 81 CMT 2

APPROVED ☒

DISAPPROVED ☐


C. E. EDGAR, III
Colonel, Corps of Engineers
Commanding

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Mr. Jan Szwed - Park Ranger LCRB
Mr. Frederic Magee - Park Ranger LCRB
Mr. Charles Freeman - Planning Division
Mr. David Buelow - Engineering Division
Mr. Russell Keeler - Real Estate Division
Mr. John Mitchell - Operations Division
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SECTION 1. INTRODUCTION

Purpose

The land and forests of Knightville Dam are valuable assets to the surrounding areas, providing recreational opportunities and preserving natural areas in public ownership as well as protecting the rivers and streams within the flood control project. The intelligent management of these lands and forests according to sound ecological principles will insure their existence for future generations and their continued productivity.

The purpose of this natural resource management plan is to provide a general description of the forest resources and fish and wildlife contained within the project boundaries, and to provide interim guidelines on the general techniques to be used to manage those resources.

Authority.

This plan constitutes Appendix B (Forest Management Plan) and Appendix D (Fish and Wildlife Plan) to the project master plan and is authorized under ER 1130-2-400, dated 28 May 1971.

Objectives

The objectives of this management plan are to outline specific practices which are compatible with flood control operations and multiple-use practices, to provide for the proper ecological management of all resources. Specific objectives are to protect and enhance natural beauty; to provide for diversified recreational use of project natural resources including hunting and fishing, nature observation and interpretation, and day use; and, where compatible and practicable, to provide wood products for project, national defense, and commercial purposes.

Coordination

This plan has been coordinated with the Massachusetts Divisions of Forests and Parks, and Fish and Wildlife; U.S. Fish and Wildlife Service; and several private groups concerned with resource management of public lands.

SECTION 2. PROJECT DESCRIPTION

Location

Knightville Dam is located in west-central Massachusetts in Hampshire County on the east branch of the Westfield River, approximately 27.5 miles above the Westfield River's confluence with the Connecticut River. The lands and water of the project are within the towns of Huntington and Chesterfield. State Route 112 provides direct access to the dam and reservoir areas, and permits access via State Routes 66, 9, and 143; Interstate Highways 90 and 91; and U.S. Route 20.

Acquisition

The Knightville Dam project was authorized by the Flood Control Act of 22 June 1936, Public Law No. 738, 74th Congress as amended on 25 May 1937 by Public Law No. 761 of the 75th Congress. Total area of the reservoir is 2,688 acres, of which 2,430 acres were purchased in fee and the remaining 258 acres are held in flowage easement. Construction began in September 1939 and was completed in December 1941. The total original cost of the project was \$3,220,445.

General

Of the 2,430 acres owned in fee at Knightville Dam, approximately 450 acres of forest and 280 acres of open land are located below spillway crest elevation at 610 feet MSL. Knightville is a dry bed reservoir and contains no permanent pool. The only significant wetland on the project is a beaver pond in the northwest section of the reservoir.

In January 1949, 100 percent of the storage capacity at Knightville Dam was utilized. Ninety-six percent was utilized in October 1955.

History

Early settlers cleared much of the original forest to develop home sites and a self-sustained form of agriculture. Stone walls, building foundations, and aged apple trees planted on old homesteads are scattered throughout the area. A second clearing occurred when valuable stands of pine were logged during the period from 1895-1925. Hemlock was also cut for its bark which was used in tanning operations. In the 1920's timber was also cut to produce charcoal. Logging last occurred on the area in 1957 when approximately 75,000 BF of timber in the northwest section of the project was sold by the Corps to Oleksak Lumber Company. A small portion of the area was mined for mica for use in war material during the early 1940's. There is a history of fire in the woodlands. Major causes of fire stemmed from burning land for clearing and negligence by hunters, fishermen, and recreationists. In October 1947, a fire blackened approximately 600 acres of forest land in the northeast portion of the reservoir.

SECTION 3. PHYSICAL AND ECOLOGICAL CHARACTERISTICS

Topography

Within Knightville's boundaries, elevations vary from 1,300 ft. msl in the hills overlooking Indian Hollow Campground to about 460 ft. msl. at streamside below Knightville Dam. The riverbottom and gentler forest lowlands give way abruptly to steeper surrounding uplands. Although the general north-south orientation of ridges results in predominant east and west facing aspects, topography is sufficiently varied to produce a mixture of aspects.

Glacial deposits, exposed bedrock and steep cliffs throughout the reservoir add character and variety to the upper slopes. Both intermittent and perennial streams also alter the local topography.

Climate

The climate of the Westfield River basin is variable, due primarily to the large differences in elevation. While the lower basin is relatively mild, the rougher topography and higher elevations at the headwaters of the tributaries are subject to a more severe climate.

The mean annual temperature in the basin ranges from about 44°F in the mountainous regions to about 50°F in the lower valleys. Extremes of 102°F and -30°F have been recorded in the basin. The average January temperature at the project is 23°F, while the average July temperature is about 70°F.

Precipitation is evenly distributed on a seasonal basis, averaging 46 inches annually. Snowfall varies widely over the basin, with an average depth of about 55 inches at the dam, elevation 630 feet above mean sea level (msl), and over 70 inches at Chesterfield, 1,425 feet msl, and Peru, 1,860 feet msl. Average annual runoff for the Westfield River near Westfield, Massachusetts has varied from 45.30 inches in 1955 to 14.82 inches in 1941 with a mean of 26.12 inches.

The mean annual runoff represents about 55 percent of the mean annual precipitation and about 50 percent of this runoff occurs in the spring months of March, April, and May.

Geology & Soils

The Westfield River drainage basin is geologically part of the Green Mountain Highlands which form a belt extending southward from Vermont across Massachusetts. The western half of this Highland is formed largely from ancient gneisses and granites, and the eastern portion from later schists, with extensive accumulations of glacial till.

An accurate, updated soils map has not been prepared for the Knightville Dam area. However, the forest soils of the area are primarily the Monroe-Blanford-Woodbridge soil association. These are shallow to bedrock and deep, well-drained and moderately well-drained soils. They have formed from glacial till and have fine sandy loam and loam textures. Monroe soils are shallow to bedrock and are found on moderate to steep slopes. They also have many ledges and in some places

contain small amounts of limestone. Blanford soils are deep, well drained, less stony and occur on plateaus and ridgetops. They have a hard layer in the subsoil and sometimes contain small amounts of partially disintegrated limestone. Woodbridge soils are moderately well drained and occupy the lower slopes.

The U.S.D.A. Soil Conservation Service is presently working toward mapping the soils of the entire State by the early 1980's. When available, this information will help guide management efforts.

Land Classification

The land at Knightville Dam has been divided into three management compartments for purposes of orientation and administration, and are defined by natural and artificial boundaries (see Map 1, Exhibit B).

Aerial photographs of Knightville Dam, taken in July 1975, were interpreted and used with ground observations to classify Government-owned land according to forest cover type, use and other factors. Acreages are given in Exhibit A, Table 1. Forest cover types and other land classifications are delineated by forest compartments on maps available at the project office.

Forest Types

There are 2,430 acres at Knightville Dam of which 2,051 are forested. Non-forested lands include 250 acres of open land usually supporting herbaceous and brushy growth in the valley floor. Approximately 77 acres are covered by the Westfield River and 9 acres exist as wetlands. Project operations cover 38 acres and there is a one-acre sand and gravel pit in Compartment 3.

The largest forest cover type area is the northern hardwoods type; sugar maple - beech - yellow birch (Type 25). This type occurs on 1,204 acres and varies in composition from pure beech⁽¹⁾ in Compartment 2 near the spillway to more diverse stands elsewhere. Common associates are Black Cherry, White Ash, Eastern Hemlock, Northern Red Oak, and Eastern White Pine. Common species in the understory are American Hornbeam and Striped Maple.

The second most common forest cover type at Knightville is Type 23, Hemlock and contains 282 acres. There are two variations common in the project area as well as elsewhere in New England. The most common variant at Knightville is Hemlock-Hardwoods. Here the predominant single species is Eastern Hemlock, with Beech, Black Birch and Yellow Birch. Other associated species are Northern Red Oak, Red Maple, Sugar Maple, Hophornbeam, and Black Cherry.

Pure Hemlock is found in smaller stands scattered throughout the area. Some Yellow, Black, and Paper Birch are also found in among the Hemlocks.

(1) A table listing the common and scientific names of species found at Knightville may be found in Appendix 2.

Northern Red Oak - Basswood - White Ash (Type 54) is the third largest type, found on 269 acres. This type consists of large Red Oaks, usually overtopping associated trees. Other species present include some White Ash, Red Maple, Sugar Maple and Eastern Hemlock. This type is found on hillsides having a south or west aspect.

Type 24, Hemlock - Yellow Birch covers 101 acres. This climax successional forest type is found on steep, rocky slopes along the Dead Branch, between the Westfield River and Horse Trail north of Florida Brook, and east of the Westfield River at the upper end of the basin opposite the campground.

Associates of the Hemlock and Yellow Birch type are Sugar Maple, Red Maple and Basswood.

Type 21, Eastern White Pine, is found on 81 acres. Six acres of exceptionally tall pine are located above the campground along Bryant Road. Other pine stands are found along the Horse Trail, along the access road to the spillway near the southern boundary and in scattered locations on abandoned fields between the Little River and the campground west of the Westfield.

Typical associates of Eastern White Pine include Northern Red Oak, Black Cherry, Sugar Maple, White Ash, Paper and Black Birches, and Eastern Hemlock.

Other less important forest types, both due to their small areas and lack of commercial value are Type 16, Aspen; Type 18, Paper Birch; Type 19, Grey Birch - Red Maple; and Type 39, Black Ash - American Elm - Red Maple.

Aspen is found on the edge between the open bottom land, and the forested slopes. Grey Birch - Red Maple is also found in similar areas.

Type 18, Paper Birch, is located on an area burned over in the late 1940's high on the hill overlooking the campground. Black Birch and Sugar Maple are associates.

The final type, Black Ash - American Elm - Red Maple is found along riverbanks on wet soils. Most of the Elm has died due to the Dutch Elm Disease (*Ceratocystis ulmi*) with Sycamore beginning to appear to fill its niche. Red Maple is the most common species of this type with Ash occurring occasionally.

Forest Inventory

A timber cruise was conducted during August 1980. Aerial photos were used to delineate forest types and to determine height classes and percentage of crown closure. Field surveys were then conducted to classify each type according to the guidelines published by the Society of American Foresters in Forest Cover Types of North America.

Variable radius plots were taken at random locations in each forest type using a cruise-all with a 10 basal area factor.

Tables 3 through 5 give estimates of timber volume by forest type and species by Compartment. Table 6 gives the total board foot volume by species on the project. The estimates were based on the International 1/4 inch rule and Gerard form class 78.

SECTION 4. FOREST MANAGEMENT

Factors Influencing Forest Management

The following factors will influence the management of forest resources at Knightville Dam. These factors need to be evaluated and considered in developing programs for forest management that will minimize adverse effects and optimize the benefits attainable from the area.

Forest Protection

The most effective method of protecting the forest from disease and insect pests is the maintenance of vigorous, healthy forest stands. Proper silvicultural practices providing a diversity of species and age classes of adequate vigor will normally prevent major infestations.

Direct approaches, i.e., chemical spraying, for disease and pest problems will be used only to deal with individual trees of extremely high value or with an infestation that has attained or is likely to attain epidemic proportions.

Insects

Several insect pests occur throughout the reservoir but have not, as yet, caused any serious damage. These include the white pine weevil (Pissodes strobi), saddled prominent (Heterocampa guttivitta), hemlock looper (Lambdina fiscellaria fiscellaria), fall webworm (Hyphantria cunea), tent caterpillars (Malacosoma spp.), and the gypsy moth (Porthetria dispar). The Indian Hollow group camping area, located at Knightville Reservoir is used by local groups and there is some possibility of their transporting the Gypsy moth egg masses outside of presently infested areas of the northeast. Information on this subject will, however, be made available at the campground.

Diseases

Various tree diseases are also present in the forest, the most significant of which is the beech bark disease. This beech scale - necrotia complex is an insect (Cryptococcus fagisuga) and fungus (Nectria coccinea van faginata) association. Through the feeding punctures of the larval stage of the insect, the Nectria fungus penetrates the bark and kills it. Present control methods consist of removal of infected trees to arrest the spread of the disease to unaffected individuals. This method will be used primarily by the issuance of fuel wood cutting permits and commercial sales. This disease is a serious problem throughout New England.

Entomologists or pathologists from the U.S. Department of Agriculture will be asked for technical advice should a serious outbreak of disease or insect damage occur.

Air Pollution

Air pollution is not known to be a serious threat to the forest on the Knightville Reservoir.

Pesticides

The use of pesticides at Knightville Reservoir is limited to herbicides used to control vegetation on the rock faces of the dam. It is unlikely that herbicides or insecticides will be used for forest management purposes.

Soil Erosion

Two locations in the reservoir were found to have soil erosion. The first is the slumping of a few hundred feet of the riverbank on the east side of the Westfield River, several hundred feet upstream from its confluence with the Little River. The high banks of fine sandy soil are on an outside curve of the river and subject to its direct current. The slump is naturally occurring but is aggravated by flood storage operations. This area is underwater most of the winter and as a result only shallow rooted herbaceous plants can grow there.

The second area of erosion is along the riverbank of the Westfield River adjacent to the Indian Hollow Campground. This bank is also subject to the direct current of the river but is rarely affected by flood storage operations.

Decisions concerning forest management activities will be influenced by site erosion potential. Unstable riverbank areas and steep slopes will be protected by maintaining good vegetative cover.

Erosion caused by unauthorized off-road vehicle use requires special protection to allow the recovery of vegetation resulting in soil stabilization. Along with physical controls such as signs, gates, or natural barriers, visitor education services combined with Park Ranger patrols will aid the recovery and protection of critical sites. Remedial structures in the form of water bars were used successfully on several eroded slopes in 1976.

Access

To satisfy increasing recreational needs and to accomplish desirable silvicultural goals, an adequate system of trails and roads will be planned, constructed, and maintained. Access, currently confined to the lowlands, will be extended into the steeper, forested uplands. Road and trail layout will be planned to provide access for fire suppression. Continuous forest cover, grassy lowlands, and a lack of access roads makes a disastrous wildfire a real possibility should a fire occur in the reservoir.

Trails for non-motorized uses will receive the greatest consideration in trail studies for forested uplands. The location of all logging and skid roads needed for silvicultural operations will receive adequate planning. The number of these roads will be the minimum necessary to accomplish the desired management objectives.

Flood Control Operations

Operation of Knightville Dam for flood control can kill standing trees by inundation. Forest management activities in the reservoir area can generate wood residues and slash that will float down to the log boom. Timber stand improvement and other silvicultural endeavors will not, in general, be warranted in those lowest

parts of the reservoir that are subject to frequent and recurring inundation. However, flood control operations have not thus far caused significant tree mortality. Three reasons are: (1) much of the lower reservoir has been cleared of trees, (2) few trees have been totally inundated during flood control storage operations because of their height and elevation in relation to maximum pool stages, and (3) no significant storage operations have yet occurred in the summer at the peak of the growing season.

Impoundment during flood periods and subsequent drawdown in the reservoir tend to create accumulations of woody debris and trash at the log boom, stop-log weir and intake gates. Therefore, it is important that slash, logging debris, and other material resulting from thinning, harvesting, and fuelwood cutting be handled and disposed of in ways which will minimize maintenance problems at the dam.

SECTION 5. FOREST MANAGEMENT PROGRAMS

General

Forest manipulation to achieve management objectives will incorporate proper silvicultural techniques including thinnings, plantings, prunings, and harvest cuts where required. Timber and cordwood will be desirable by-products.

Tree harvesting is an indispensable tool of forest management. Cuttings are utilized to regulate the composition, tree distribution, productivity and environment of the forest. By their prudent use a healthy, vigorous forest containing a variety of tree species and age classes can best be established and maintained. A forest is a dynamic community in which a constant life and death struggle takes place between plants as they compete for sunlight, water, and nutrients. The whole forest is wildlife habitat and the animals therein are constantly engaged in a struggle for survival. Since the forest is not a static community, changes are inevitable with or without man's aid.

Silvicultural Systems

Uneven-aged management is one silvicultural system suited to meet many specific goals of management. Uneven-aged stands may be developed and maintained and desirable species continuously established by applying variations of selection harvesting. Cuttings repeated indefinitely and at short intervals create and perpetuate the uneven timber stand. Because a residual stand always covers the site and logging disturbance is less apparent, uneven-aged management is best suited where aesthetic considerations are paramount.

Where uneven-aged management is chosen, managers will employ the selection method to foster such shade tolerant tree species as beech, maple, hemlock, and intermediate tolerants like ash, sweet and yellow birch, white pine, and red oak. Heavy selection thinnings may be employed in stands where very shade intolerant species are to be regenerated. Where major reservoir roads and scenic overlooks are nearby, light thinnings may be used in buffer strips around these areas.

Group selection, whereby small groups of trees are removed to open areas large enough to establish reproduction, will be employed to regenerate shade intolerant species.

Patch cuttings, one-half acre to one acre in size, will be used to establish and perpetuate stands of aspen, cherry, and other intolerants beneficial to wildlife. Cuttings will be permitted in secluded areas away from public view and perennial streams, at least 100 feet from roads and water edges.

Pruning

Pruning will be conducted to improve forests for greater aesthetic, wildlife and recreation benefits. Removal of branches from the first 16-foot log on young sawtimber will be limited, unless it is consistent with these benefits. The high cost of pruning may be absorbed by the value of knot-free timber by-products.

Plantings

Natural regeneration is expected to perpetuate the forest stands now existing on the reservoir. Buffer strips of trees and shrubs may be planted to screen undesirable features of the landscape, to provide food and cover for wildlife, or for erosion control.

Thinnings

A complete forest inventory conducted in 1980 determined thinning needs for immature stands. Once stand examinations begin, the method and timing of all intermediate cuttings and all prunings will be designated for specific stands.

Thinnings reduce competition among trees for light, moisture and nutrients and encourage the development of understory and ground vegetation which is needed for wildlife food and cover requirements. Thinnings are used to increase growth in stagnated stands, to maintain inherent growth of young stands, to increase growth on desired trees, to regulate stand density, and to create a diversity of species and age classes. The operation usually involves removal of poor risk and poor quality trees.

Maintenance of stand vigor is important but will be subordinate to stand attractiveness in recreation developments. In the vicinity of recreation sites, cutting will be limited to removing hazardous, dying, or diseased trees that threaten the health and beauty of the forest or the safety of its users. Care will be taken to prevent damage to residual trees and ground vegetation. Slash may be chipped and used as mulch on critical sites. If the slash is to be piled, it will be done in such a manner as to provide cover for wildlife. All stumps will be cut close to the ground.

All cuttings will be done with attention to how residual stands will look, and will create an interesting variety of forest patterns. Trees and shrubs that add to the beauty of flowers in the spring and of colorful fruit and foliage in the autumn will be favored. In some stands, thinnings will be used to release promising young oaks and other trees having potential for greater mast production.

Timber Harvests

Forested areas in the reservoir are in need of silvicultural treatments to increase tree vigor, improve form, release suppressed trees, harvest mature timber and otherwise to enhance the productivity of forest species desirable for aesthetics, wildlife, and forest products.

Large, high quality saw timber exists in the mature northern hardwood type (25-3-A). Large beech trees in this type are being killed by the beech bark disease. Commercial sales to remove these and other poorly formed or defective trees will be conducted. Immature pole or small sawlog trees will be thinned to remove low quality trees. A Silvicultural Guide for Northern Hardwoods in the Northeast (Leak et al.) will be used to guide management activities. Sawtimber in the mature, dense, hemlock (23-3-A) and the hemlock - yellow birch type (24-3-A) should be harvested before the hemlock becomes overmature and defective. Selection harvesting will create an all aged, diverse forest. Commercial firewood sales to remove defective hardwoods in these types will also be made, along with a firewood permit program where easy access is available.

The black ash - American elm - red maple type (39) occurs in wet areas and has limited operation potential. Firewood permits should be used to harvest the dead standing elm and thin the low quality red maple. Forest stand types (39) and (19) should be investigated for high yield fuelwood production areas. Coppice standards will grow to diameters no greater than twelve inches DBH to facilitate removal via fuelwood permits.

Several areas in the white pine type (21) contain mature timber which should be harvested in a commercial selection cutting. Remaining young trees should be pruned to 16' by project personnel. A Silvicultural Guide for White Pine in the Northeast (Lancaster et al.) will be used in guiding management considerations.

The mature northern red oak - basswood - white ash type (54) in compartment 2 contains a quantity of large diameter sawlogs that should be harvested. Thinnings via commercial firewood sales should be made in this type to remove defective trees and trees of inferior species that are competing with younger more valuable ones. Firewood permits could also be used in the more accessible areas of this type. The Silviculture of Oaks and Associated Species (Clark) will be used as a guide.

Boundary Maintenance

Contract re-surveying and monumentation of Knightville Reservoir was completed in 1979. Boundary lines between monuments will be marked to make it easier for public visitors to know when they are entering or leaving project lands, to lessen the possibility of encroachments by adjacent property owners, and to allow personnel to identify project boundaries when carrying out maintenance and forest management activities. The initial blazing and painting of the boundary lines between established monuments will be done by contract. Funds will be budgeted for Fiscal Year 83 and work accomplished during the first quarter of that fiscal year. Subsequent maintenance of the boundary will be performed by project personnel on a five year cycle. The Park Ranger will have primary responsibility for the periodic inspection of boundaries for timber trespass and other unauthorized uses of government land.

Management Direction

All silvicultural operations will be implemented under the direction of the LCRB Park Ranger/Forester. The LCRB forester will specify stand prescriptions and mark trees to be cut prior to undertaking silvicultural work.

Aesthetics

The aesthetics of the Knightville Reservoir area are very important and must be protected. No silvicultural operations should adversely affect aesthetics on a long-term basis.

Restrictions on tree removal will be maintained in areas having unique natural, archaeological, historical or geological importance. Rock quarries, caves, outcrops, cellar holes, mill sites and exceptional timber may be included. An old mill site existing upstream of the beaver dam, an old quarry, the peak of the mountain overlooking the Indian Hollow Campground, an old mill site and canal on

Dead Branch Brook and an "old growth" white pine stand north of the campground are some known areas deserving special forest management practices.

Compartment 3, which includes the mountain overlooking Indian Hollow Campground will be left in its natural state for the enjoyment of those visitors seeking solitude and natural beauty. All access will continue to be by foot or on horseback only. Management will be limited to trail construction and maintenance, and to erosion control on trails. The area will be reviewed in five years with the intent of a limited harvest operation.

Monitoring of Forest Conditions

The general conditions and trends of the forests in the reservoir must be monitored periodically to assess the effectiveness of silvicultural programs and to determine whether modifications to the management plan are called for. The forests should also be checked regularly for signs of developing disease and insect problems so that corrective work can be undertaken if necessary. Cruises should be conducted in operable areas at five year intervals to add to the information base concerning the forest resource and to determine where silvicultural work is needed.

Short-Range Forest Management Programs

Programs that should be implemented in the near future (1-5 years) are described in the following paragraphs.

Erosion Control

Action will be taken to stabilize and prevent further deterioration of the two areas of erosion on the riverbank. The Corps of Engineers is presently engaging in an erosion control study on the banks of the Connecticut River in Northfield, Massachusetts wherein several different corrective methods of preventing bank erosion are being assessed. When definite results are known, the most efficient and economical method will be applied to Knightville's erosion problem.

Overlook Area

Investigate the feasibility of the construction of a scenic overlook on Route 112 in cooperation with the Massachusetts Department of Public Works and any other interested agency. An overlook similar to the one on Route 202 in Pelham, Massachusetts overlooking the Quabbin Reservoir is suggested.

Firewood Permit Program

Institute a fuelwood permit program along gravel roads in the basin to remove dead and dying trees and any usable woody material deposited during periods of high water.

Timber Stand Improvements

Perform timber stand improvement work in areas adjacent to the Indian Hollow Campground to provide firewood and also to be used as examples of proper forest management.

Long Range Forest Management Programs

Harvest dead and dying beech and low quality hardwoods in commercial firewood sales.

Harvest mature and overmature sawlog timber through commercial sales.

SECTION 6. AQUATIC RESOURCES

General

Aquatic species presently managed at Knightville Reservoir concern the cold water fishery: rainbow (Salmo gairdner), brown (Salmo trutta), and brook (Salvelinus fontinalis) trout which are stocked seasonally. Within the reservoir area, rough fish such as creek chub (Semotilus atromaculatus), white sucker (Catostomus commersoni), and blacknose dace (Rhinichthys atratulus) are also present.

Typical warm water species inhabiting the Westfield River are yellow perch (Perca flavescens), white perch (Morone americana), brown bullhead (Ictalurus nebulosus), chain pickerel (Esox niger), as well as small mouth (Micropterus dolomieu) and largemouth bass (Micropterus salmoides).

Snakes and various amphibians thrive in the aquatic environment. It is not known if any endangered or unique aquatic plant or animal species inhabit the Knightville Reservoir area.

Existing Management

Current fisheries management, is the responsibility of the Massachusetts Division of Fisheries and Wildlife, and is confined to trout stocking. Species composition and stocking numbers vary yearly with availability. An attempt is made to meet part of the high demand for fishing opportunities. Fish are stocked in numerous places along the East Branch and Little River to assure that they are well dispersed. Fluctuations in yearly allotments may result in slightly understocked waters but fish populations are considered stable. Measurements of water parameters are made prior to stocking to insure adequate fish survival and high fishing success under current management objectives.

Fish have been stocked in recent years as follows:

1978	East Branch, Westfield River	Little River
Brown Trout	100	
Rainbow Trout	2,400	400
Brook Trout	500	
1979		
Rainbow Trout	750	1,400
Brook Trout	1,825	
1980 (Spring)		
Brown Trout	600	
Rainbow Trout	2,500	1,000

Normal spring trout stocking may be delayed by impoundments in conjunction with flood control operations which temporarily disrupt the habitat. Additional fall stocking may be accomplished to extend the optimum fishing period if there are fish available at the hatchery, and adequate water levels in the streams.

In late summer, warm water temperatures force trout to seek out the cooler water of the deeper pools in the river. An examination will be made to determine the feasibility of artificially increasing this type of critical habitat.

Waterfowl

Canada geese (Branta canadensis), snow geese (Chen hyperborea), mergansers and several species of ducks visit the reservoir, although they are infrequent and in low numbers. Minor wetland areas within project boundaries do not provide sufficient nesting food and cover habitat for waterfowl. Waterfowl hunting is subsequently limited.

Waterfowl management will consist of improving nesting habitat for wood ducks (Aix sponsa) with artificial nesting structures, saving cavity or den trees near water areas, and managing larger ponds. Where depleted food supplies have forced beavers to vacant areas, water level structures will be installed to maintain beaver flowages and environments suitable to many waterfowl.

Aquatic Furbearers

The small acreage of wetland habitat and drastic water level fluctuations caused by flood control operations severely limits the diversity and number of aquatic furbearers.

Management efforts will be concentrated on maintaining the wetland created by beavers in the northwest portions of the reservoir.

Factors Influencing the Management of Fish

Water Quality

Both the East Branch of the Westfield River and the Little River are of Class B water quality according to the Commonwealth of Massachusetts. Class C is the minimum rating of water available for recreation use.

Water quality characteristics at Knightville are routinely gathered and analyzed by the NED Engineering Division.

Particular values of water quality are important for the present stocking program on the East Branch. Although turbidity has little influence on present trout management, this factor may determine the success of other aquatic species. Dissolved oxygen, acidity, and water temperature values, however, are critical to the present stocking program. Low river flows and warm weather occurring in late summer affects water temperature and dissolved oxygen levels, creating situations where stocking is impractical.

Acidity change, although seasonal, is often critical for stocking success in this part of the Westfield basin. Runoff influenced by valley soils may alter pH in streams and tributaries. When the pH is below 6 or higher than 8, no stocking is attempted.

Water Level Fluctuation

For all seasons of the year, periods of impoundment created in conjunction with flood control operations are normally short termed. Since Knightville is a dry-bed reservoir and stream slopes are relatively deep and narrow, regulation usually returns water levels to normal in a few days time. Frequency as well as timing of water level fluctuations may, however, produce negative impacts on shallow water life forms and fish and wildlife. Monitoring of the environment behind Knightville Dam is necessary and recommended to determine the effects of substantial changes in water level incurred during flood regulation. Fluctuations in spring runoff can result in loss of habitat and mortality in trout. To date, this situation has not produced significant fish kills at Knightville. Generally, losses in the food base, insect life, etc., will be the life limiting factor.

Aquatic Vegetation

Aquatic plants provide an environment suited to many aquatic organisms. When weed densities are not excessive, protective shade cover and food quality in these areas permit the survival of abundant aquatic wildlife. No data are available on aquatic weed species inhabiting the East Branch. The extent of weeds on the main stem or tributaries is not considered significant enough to cause problems for the fishery, or angler opportunity.

Reservoir Clearing

The majority of the reservoir bottomland was formerly farmland pasture. Because Knightville is a drybed reservoir, little clearing of wooded areas took place during construction. The periodic inundation of the reservoir bottomland has held back forest succession in this area, resulting in its remaining in low-growing willow-alder-herbaceous vegetation. Stumps and trees deposited on the bottomland by high water are usually removed in the summer to prevent their being transported into the intake channel and trash racks during subsequent flood control regulation.

Pesticides

Use of insecticides and herbicides on Knightville Reservoir will be subject to constant review. Herbicide use to control undesired vegetation for project operations will continue and the impact of applications monitored. Aquatic habitats tolerate only limited amounts of these substances since they are absorbed into the food chain. Mortality of benthic organisms, even on a short-term basis, degrades the fishery. Pesticide applications for both project operations purposes and resource management practices will be carefully considered to measure impacts. Federal and State regulations will be followed when pesticides are applied.

Access and Fishing Pressure

Stream fishing is available throughout the project area and is particularly popular and heavy in spring and early summer in the deeper pools of the Westfield River stocked with trout. Access to these areas is by way of unimproved roads along the main stream and tributaries, see Exhibit B, Map 2. Vehicular gate barriers have been installed on the Indian Hollow and Valley Roads in order to

reduce enforcement problems for State and local police and project personnel, particularly at the Indian Hollow Campground. The product is an improved recreational environment accessible by foot. Within project boundaries, the east bank and Indian Hollow Campground area receive considerably less angler attention than the west bank, except during the height of the fishing season. With vehicular restrictions on the upper portion of the reservoir, fishing pressure has increased in areas below the gate. All streams in the project area are available for fishing, with varying degrees of access.

Commercial Fishing

Aquatic populations are not large enough to sustain commercial fishing. Fish are stocked for modest sport fishing on a put-and-take basis.

Fisheries Management Program

Short Range Management

A creel census will be undertaken to determine angler utilization and interest in the fishery. This survey will provide information which will assist in determining the adequacy or necessity of the existing stocking program.

Old Route 112 and that portion of Indian Hollow Road south of the vehicle barrier should be graded and maintained periodically to keep it in a usable condition for anglers and other visitors to the project.

Long Range Management

The stocking program should be reassessed in light of results of the creel census.

Water quality is periodically monitored to assure that a stabilized aquatic habitat is maintained and as a basis for monitoring potential pollution.

An element of the NED Water Quality Monitoring Program is the General Limnological Survey. This survey is conducted in cooperation with appropriate State agencies to determine species composition, benthic organisms, aquatic productivity and other parameters necessary to assess an aquatic habitat.

The waters at Knightville Dam will be surveyed with the goal of determining the condition of the trout fishery and to make specific recommendations as to stream areas that would need modification to improve fishery habitat.

SECTION 7. WILDLIFE MANAGEMENT

Major Species

Adjacent to Knightville's water areas, open bottomland and forested slopes support varying populations of wildlife species. Upland game species include woodcock (Philohela minor), ruffed grouse (Bonasa umbellus), cottontail rabbit (Sylvilagus floridanus), snowshoe hare (Lepus americanus), and grey squirrel (Sciurus carolinensis). Pheasants (Phasianus colchicus torquatus) stocked for fall hunting may supplement natural populations. Small mammals and songbirds are also found on the area. Populations of beaver (Castor canadensis), red fox (Vulpes fulva), and grey fox (Urocyon cinereoargenteus), raccoon (Procyon lotor), striped skunk (Mephitis mephitis), short tail weasel (Mustela erminea), porcupine (Erethizon dorsatum), and various other species are present. On occasion, black bear (Ursus americanus) and bobcat (Lynx rufus), have been sighted.

The whitetail deer (Odocoileus virginianus) is one big game animal receiving considerable hunting pressure. Depletion of habitat, human intrusion, and other factors have reduced the number of deer in the reservoir. Natural succession from young to mature forest has not favored the whitetail. State laws enacted and enforced by the Massachusetts Division of Fisheries and Wildlife provide the needed regulation to protect many species, although maintenance and protection of species diversity and numbers requires a more active habitat management program. Both game and non-game species provide abundant hunting and wildlife observation opportunities.

License Agreement

Under a license agreement, the Massachusetts Division of Fisheries and Wildlife has responsibility for wildlife management on 296 acres at Knightville Reservoir - See Exhibit B, Map 5. Pheasant stocking is currently the major terrestrial program conducted on the reservoir. Both short and long-term goals include this activity in order to accommodate the great demand for pheasant hunting opportunities. Past practices have included limited plantings of seed and grain crops and brush cutting for habitat improvement. Winter rye, buckwheat, multiflora rose and other grasses and herbaceous crops have been planted for wildlife.

Non-forest areas continue to be the main location for management. In recent years, more frequent impoundments associated with flood control operations have held back plant succession in the river bottomlands, and the urgency for brush cutting has been reduced. Wildlife management areas are shown on Exhibit B, Map 2.

Because "put and take" pheasant management is a major concern, little wildlife management is aimed at other terrestrial species. Parameters necessary for sound management, including wildlife population estimates, species composition and trends are largely unknown for Knightville lands, but are available on an area basis from the Massachusetts Division of Fisheries and Wildlife. The completion of a comprehensive game and non-game census for the entire western Massachusetts region is anticipated by the Massachusetts Division of Fisheries and Wildlife in the early 1980's. The results of this research effort will be useful in guiding management efforts.

Forest Management Effects on Wildlife

An active forest management program is essential to safeguarding and improving wildlife habitat and improving the numbers and diversity of wildlife species. Forest stands at Knightville, as mentioned, are predominantly mature northern hardwoods and softwoods of high crown density. Understory vegetation supplying food and cover for most wildlife suffers in the competition for space, sunlight, moisture, and nutrients.

Silvicultural practice including timber harvesting, regeneration and improvement cuttings will be applied to enhance the understory and produce young, healthy trees and stands. Remaining vegetation will become less susceptible to insects, diseases, and other natural injuries. Current infestations of beech bark disease will be decreased by sanitation or salvage cuttings.

Silvicultural treatment will maintain a healthy, diversified forest and is the best form of forest protection. Harvesting and thinning will be used to increase or improve mast-producing hardwoods and other food producing tree species. Small clearcuts will be made at strategic locations to favor aspen, cherry, birch and other intolerants utilized by many wildlife forms. Prescribed burning may be used to maintain pioneer species and berry producing plants that benefit wildlife.

Once forest management activities are programmed and implemented the relationship between these activities and wildlife needs will be assessed.

Treatments may utilize the individual tree and/or group selection methods to regenerate uneven-aged forest stand classes and sustain tree species diversity. One-half to one acre clearcuts will also be employed in strategic spots for deer and other species habitat management. Some even-aged management in these mature, predominantly northern hardwood stands will benefit wildlife. Pheasant population dynamics will be altered by forest practices that create intermingled forest and field environments.

Besides harvesting, silvicultural practices such as improvement cutting will alter forest conditions. Songbird populations will react differently based on the kind and severity of cutting. In most areas accessible to public visitors, population increases are desirable to improve the opportunity for wildlife observation. Scenic quality, in addition to wildlife numbers, will be improved when significantly large cutting or thinning operations produce more ecotones and vistas pleasing to the eye.

Precautions will be taken to prevent soil erosion and resulting vegetation losses in all forest management operations. Light selection cutting will be conducted along annual streams and up to buffer strips around the major public roads and scenic overlooks. Where skidding across streams is necessary, diversion ditches and other necessary devices will be employed to arrest stream sedimentation. Den and nest trees will be left standing, as will a number of dead trees, for wildlife that require cavities. Forest manipulation will coordinate wildlife treatments with aesthetic, recreation, and other resource objectives. A network of roads, suitable for fire protection, will be created in conjunction with resource needs.

Habitat Improvement

Because most of the land surrounding the Knightville Reservoir is wooded, the need to maintain and increase open areas is pressing. Wildlife benefit from these openings which provide forbs and grasses for their use, and from the ecotone which exists between the borders of fields and woods. Many species of wildlife, including most game species, are found in the ecotone between woods and fields and may disappear if openings are eliminated. Existing fields will be maintained by brushing out and flail mowing as recommended by the Park Ranger or Resource Manager.

Many old apple trees occur throughout the reservoir and are an important food source for deer, bear, ruffed grouse, squirrels, and others. Efforts will be made to release and maintain these apple trees by removing overtopping trees. In addition, apple trees should be planted in appropriate areas such as old fields.

Quaking aspen, an important tree species for ruffed grouse, should be encouraged by cutting back existing stands to stimulate growth of new aspen shoots.

The establishment of food plots in field areas adjacent to wooded areas and near the river will benefit many species, including waterfowl and upland game. Where appropriate, crops such as corn, rye, and barley along with apples, autumn olive (Elaeagnus umbellata), and multiflora rose (Rosa multiflora) should be planted on the borders of fields, or eroding areas, and in clumps or lines in the center of large open areas.

An effective management technique for cottontail rabbits is the placement of brush piles around the edges of fields and in forest openings. These piles are readily used as concealment and shelter from the weather. Piles should be about 10 feet wide by 4 feet high and loosely stacked. One end may be propped up on a log or rock. Numerous other species such as mice, grouse, and many small songbirds use these piles as escape cover from predators.

Food and Cover

An abundant supply of seeds, insects, and cover plants exists naturally on the valley floor for present pheasant management and wildlife in general. However, larger, more diverse wildlife populations can be expected in many instances from habitat manipulation for improved food production and cover.

It is also necessary to assess present vegetation types, plant successional trends, and features in the landscape affecting wildlife diversity and number. Inventory techniques and sampling procedures appropriate to Knightville's valley floor are established in the literature.

With accurate data to aid decision-making, the establishment of hedgerows and artificial nest structures will be considered.

Estimates of average food and cover production are available from the comprehensive forest inventory and survey of bottomland vegetation types. Understory species, natural reproduction and stand density are among the parameters measured. Mast and fruit production from oaks, beech, and other trees and shrubs can be increased with appropriate management techniques.

Wildlife Management Areas and Access

Approximately 300-400 acres of open river bottom are available for hunting pheasant, cottontail rabbit, woodcock and other game. Installation of vehicular gate barriers for visitor control limit upper areas of the reservoir to foot travel and is expected to concentrate hunting pressure in flats one to two miles above Knightville Dam. Access to the lowlands is adequate. Hunting access is the same as that for fishing.

Forested areas attract many hunters interested in whitetail deer or grey squirrel. Current forest conditions provide diverse hunting opportunity which will increase when project woodlands receive active management. Potentials for hiking trails and fire roads will be explored to encourage hunting use at Knightville.

Wildlife Observation

Beyond the economic and sporting value of numerous wildlife species, Knightville's fauna have an aesthetic value for those interested in wildlife observation. Small mammals and birds residing on the fringes of picnic areas, campgrounds and the dam are perhaps the more noticeable resident creatures. Visits by sightseers will be enhanced by good silvicultural practices aimed at creating adequate food, cover, and water conditions for wildlife near these sites.

Scenic vistas overlooking the reservoir should be made in locations adjacent to Route 112 in cooperation with the Massachusetts Department of Public Works. These will provide opportunities for roadside viewing of hawks, songbirds, and other wildlife. Openings strategically placed to blend with the landscape and to provide vistas will expose many wildlife forms to public visitors.

The field and stream environment in the river bottom also provides ample opportunity for visitors to explore these habitats for insects, amphibians and higher life forms. Though restricted during periods of flood regulation, picnickers and other recreational day-users can gain access to areas above the dam area at any time.

Further upstream, scattered fields and woodlands furnish the foot-traveler with increased opportunity for wildlife observation. A few trails and abandoned logging roads also currently offer access to some forested slopes and ridges. Management will include enhancing present trails and establishing and maintaining new hiking trails and fire roads that will improve visibility and habitat for wildlife. Trailsides may be widened to allow an edge habitat to develop along these avenues. Opportunities for wildlife observation and study, now almost completely restricted to the valley floor, will thus be extended to forested slopes and ridges.

SECTION 8. INFORMATION-EDUCATION

General

Information and education are important aspects of the forest, fish and wildlife management program. It is imperative that the public be informed of management decisions and programs. Efforts will be made to publicize programs and actions, such as timber cuts.

Education efforts will be directed at explaining the purposes behind management and broadening the general public's understanding of ecological relationships.

The image and understanding of the Corps recreation-resource management program can only be enhanced by public contacts initiated through an organized public relations program.

Current information and education efforts concerning forests, fish and wildlife at Knightville Reservoir will be expanded to include attractive brochures that are educational, informative, and specific to the property.

Interpretive Programs

As wildlife management progresses at Knightville, enjoyable and informative recreational programs will be instituted to increase public awareness and encourage wise use of wildlife resources on the project. Nature programs at campground areas will be improved in order to stimulate greater public interest and participation. Interpretive nature trails will be planned and developed where feasible.

To meet the increasing demand for conservation education programs from schools and the general public, a portion of the Visitor Information Center at Knightville will be devoted to exhibits on natural resources and their management. Wildlife mounts, models, movies, and other exhibits may be utilized. The structure, operation, and role of Knightville Dam, available recreational facilities and opportunities, and the resource management effort in the reservoir will also be explained.

Whether open year-long or seasonally, the facility will attract and educate many visitors—especially from the nearby, densely-populated communities of Westfield, Springfield, Chicopee, and Holyoke.

SECTION 9. SPECIAL NEEDS

Rare, Endangered and Threatened Species

As directed by the Endangered Species Act of 1973, threatened, rare, or endangered species must receive high consideration in all resource or project operations activities. Present research needs include a survey of plants and animals requiring special management and protection at Knightville. In Massachusetts, the rare osprey (Pandion haliaetus carolinensis) and the uncommon Turkey vulture (Cathartes aura subsp.) have been sighted at the reservoir.

A program involving education, surveillance, and management of endangered or rare species will be instituted. Until detailed studies at Knightville identify areas known to be occupied by the species in question, surveillance of possible habitats by field managers is advised for terrestrial wildlife. Records will be kept on observations and findings of both plants and animals to help determine the status of all endangered species.

Training

Cooperation with all resources agencies in the planning and action stages of wildlife management will incorporate interagency training and university instruction for field managers. Implementation of current programs by the Massachusetts Division of Fisheries and Wildlife will involve sharing of personnel as part of the desired cooperative assistance.

Multi-disciplinary training will receive high attention but participation in on-site resource management activities will also be stressed. Procedures and standardization of user surveys and status of current fish and game laws are among many items in which Corps rangers need instruction. As conditions arise, managers are urged to identify other training needs and coordinate programs applicable to their management activities.

Research Cooperation

The Corps of Engineers supports university research and studies that attempt to solve current wildlife management problems. Knightville Reservoir is open for any such activities that will benefit the education of university students, research personnel and environmental programs at Knightville. Resulting research will lead to better resource management.

SECTION 10. FIVE YEAR WORK PLAN

General

The short range management programs delineated in this plan should be implemented within the next five years. Annual work plans will be developed in detail for a five year period by project personnel, and updated annually. Work plans will be consistent with the overall objectives of the management plan, acceptable Corps of Engineers practices, and available funds.

Initial Work Plan

Year 1.

Maintain open fields, release and prune apple trees

Maintain visitor access road

Fuelwood permit program implementation

Year 2.

Creel census

Wood duck & other birdbox construction

Scenic overlook study

Investigate water level control structures

Years 3 - 5

Boundary line marking

Erosion control on riverbank locations

T.S.I. work near campground

Commercial firewood sales

Selective cutting in mature saw timber

Disposal Plan

When commercial thinning and selective cutting operations are carried out, and the forest products are determined to be surplus to project needs, a disposal plan will be prepared.

SECTION 11. PERSONNEL AND FUNDING REQUIREMENTS FOR
IMPLEMENTATION OF THIS PLAN

The following personnel and funding will be needed to begin the short range programs in Year 1, initial work plan.

Release and prune apple trees:

1 GS-5/7 Park Ranger for 2 weeks	=	\$1,013.00
1 GS-04 Forest Tech. for 2 weeks	=	833.00
1 P/U at \$25/day for 2 weeks	=	250.00
1 Chainsaw at \$10/day for 2 weeks	=	100.00

Maintenance of fields through cutting by project personnel:

1 WB-05 for 2 weeks	=	\$832.00
1 Tractor (project owned) at \$25/day	=	250.00

Fuelwood Permit Program

1 GS-07 Park Ranger for 10 days to mark trees	=	\$1,013.00
1 GS-02 Park Aid for 14 days	=	166.67
(Fri., Sat., Sun., during the summer to monitor cutting)	=	\$450.00

Maintenance of Old Rte. 112 and Old Valley Rd. to the North Gate by contractor	=	\$3,000.00
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Lancaster, Kenneth F. and William B. Leak, A Silvicultural Guide for White Pine in the Northeast, for Serv. Gen. Tech. Report NE-41, Northeastern Forest Experiment Station, Broomall, PA. 1978.

Leak William B., Dale S. Solomon and Stanley M. Filip, A Silvicultural Guide for Northern Hardwoods in the Northeast, Forest Service Research Paper NE-143, Northeastern Forest Experiment Station, Broomall, PA. 1969.

The Silviculture of Oaks and Associated Species, Forest Service Research Paper NE-144, Northeastern Forest Experiment Station, Upper Darby, PA. 1970.

Society of American Foresters, Forest Cover Types of North America, Bethesda, MD. 1954.

EXHIBIT A. Tables

Table	Title
1	Land Classification and Forest Types (Acres)
2	Common & Scientific Names of Trees
3	Timber Volume Estimate for Individual Species and Forest Cover Type - Compartment 1
4	Timber Volume Estimate for Individual Species and Forest Cover Type - Compartment 2
5	Timber Volume Estimate for Individual Species and Forest Cover Type - Compartment 3
6	Total Timber Volume Estimate for Individual Species

EXHIBIT A

Table 1

Land Classification and Forest Types (ACRES)

	Comp. 1	Comp. 2	Comp. 3	Total
Powerline		4	-	-
Project Operation/lawn	38	-	-	38
Wetland	3	-	6	9
Sand/Gravel	-	-	1	1
Water	20	17	40	77
Open/herbaceous	168	4	78	250
Forest	426	776	850	2,051
Total	655	800	975	2,430
Forest Types				
Aspen				
16-1	-	-	6	6
16-2-A	3	-	7	10
16-3-A	6	-	-	6
Paper Birch				
18-3-A	-	23	-	23
Grey Birch - Red Maple				
19-3-A	6	-	-	6
White Pine				
21-3-A	16	-	53	69
21-4-A	-	-	6	6
21-6	-	-	6	6
Hemlock				
23-3-A	74	132	76	282
Hemlock - Yellow Birch				
24-3-A	47	44	10	101
Sugar Maple - Beech - Yellow Birch				
25-3-A	234	305	665	1,204
Black Ash - American Elm - Red Maple				
39-1	-	9	-	9
39-2-B	-	-	3	3
39-2-C	36	-	2	38
39-6	-	-	13	13
Northern Red Oak - Basswood - White Ash				
54-1	-	9	-	9
54-3-A	4	253	3	260
TOTALS	426	775	850	2,051

Table 2

Common and Scientific Names of Trees at Knightville

Ash, black	Fraxinus nigra
Ash, white	F. americana
Aspen, big tooth	Populus grandidentata
Aspen, trembling	P. tremuloides
Basswood	Tilia americana
Beech, American	Fagus grandifolia
Birch, black	Betula lenta
Birch, grey	B. populifolia
Birch, paper	B. papyrifera
Birch, yellow	B. alleghaniensis
Elm, American	Ulmus americana
Hemlock, eastern	Tsuga canadensis
Hophornbeam	Ostrya virginiana
Hornbeam, American	Carpinus caroliniana
Maple, red	Acer rubrum
Maple, striped	A. pensylvanicum
Maple, sugar	A. saccharum
Oak, northern red	Quercus rubra
Pine, eastern white	Pinus strobus
Sycamore	Platanus occidentalis

Table 3

Timber Volume Estimate for Individual Species and Forest
Cover Types - Compartment 1

Board Foot International 1/4 Inch Rule						
	21-3-A 16 Ac.	23-3-A 74 Ac.	24-3-A 47 Ac.	25-3-A 234 Ac.	54-3-A 4 Ac.	Total
White Pine	133,552			111,618	1,056	246,226
Black Cherry	9,328			29,952		39,280
Sugar Maple	1,728		38,681	298,116	3,536	342,061
Hemlock	5,680	498,390	113,411	151,164	2,836	771,481
White Ash	3,232			36,738	512	40,482
Black Birch		17,538		56,628		74,166
Red Oak		666,000		192,582	19,352	278,534
Paper Birch		11,100				11,100
American Beech		11,248		427,050	596	438,894
Yellow Birch			61,147	202,878		264,025
Basswood			29,798			29,798
Red Maple					584	584
TOTAL	153,520	604,876	243,037	1,506,726	28,472	2,536,631

Table 4

**Timber Volume Estimate for Individual Species and Forest Cover
Types - Compartment 2**

	Board Foot International 1/4 Inch Rule				
	23-3-A 132 Ac.	24-3-A 44 Ac.	25-3-A 305 Ac.	54-3-A 253 Ac.	Total
Hemlock	889,020	106,172	197,030	179,377	1,371,599
Black Birch	31,284		73,810		105,094
Red Oak	118,800		251,015	1,225,014	1,593,829
Paper Birch	19,800				19,800
American Beech	20,064		556,625	37,697	614,386
Yellow Birch		57,244	264,435		321,679
Basswood		27,896			27,896
Sugar Maple		36,212	388,570	223,652	648,434
White Pine			145,485	66,792	212,277
White Ash			47,885	32,384	80,269
Black Cherry			39,040		39,040
Red Maple				36,938	36,938
TOTAL	1,078,968	227,524	1,963,895	1,800,854	5,071,241

Table 5

Timber Volume Estimate for Individual Species and Forest Cover
Types - Compartment 3

Board Foot International 1/4 Inch Rule

	21-3-A 53 Ac.	21-4-A 6 Ac.	23-3-A 76 Ac.	24-3-A 10 Ac.	25-3-A 655 Ac.	54-3-A 3 Ac.	Total
White Pine	442,391	89,388			317,205	792	849,776
Black Cherry	30,899				85,120		116,019
Sugar Maple	5,724			8,230	847,210	2,652	863,816
Hemlock	18,815		511,860	24,130	429,590	2,127	986,522
White Ash	10,706				104,405	384	115,495
Red Oak		2,418	68,400		547,295	14,514	632,627
Black Birch			18,012		160,930		178,942
Paper Birch			11,400				11,400
American Beech			11,552		1,213,625	447	1,225,624
Yellow Birch				13,010	576,555		589,565
Red Maple						438	438
Basswood				6,340			6,340
TOTAL	508,535	91,806	621,224	51,710	4,281,935	21,354	5,576,564

Table 6

Total Timber Volume Estimate for Individual Species
Board Foot International 1/4 Inch Rule

White Pine	1,308,279
Hemlock	3,129,602
Sugar Maple	1,854,311
Black Cherry	194,339
White Ash	236,246
Black Birch	358,202
Red Oak	2,504,990
Paper Birch	42,300
American Beech	2,278,904
Yellow Birch	1,175,269
Basswood	64,034
Red Maple	37,960
TOTAL	13,184,436 B.F.

Exhibit B. Maps

Map	Title
1	Forest Compartments of Knightville Dam
2	Wildlife Management Area/Access

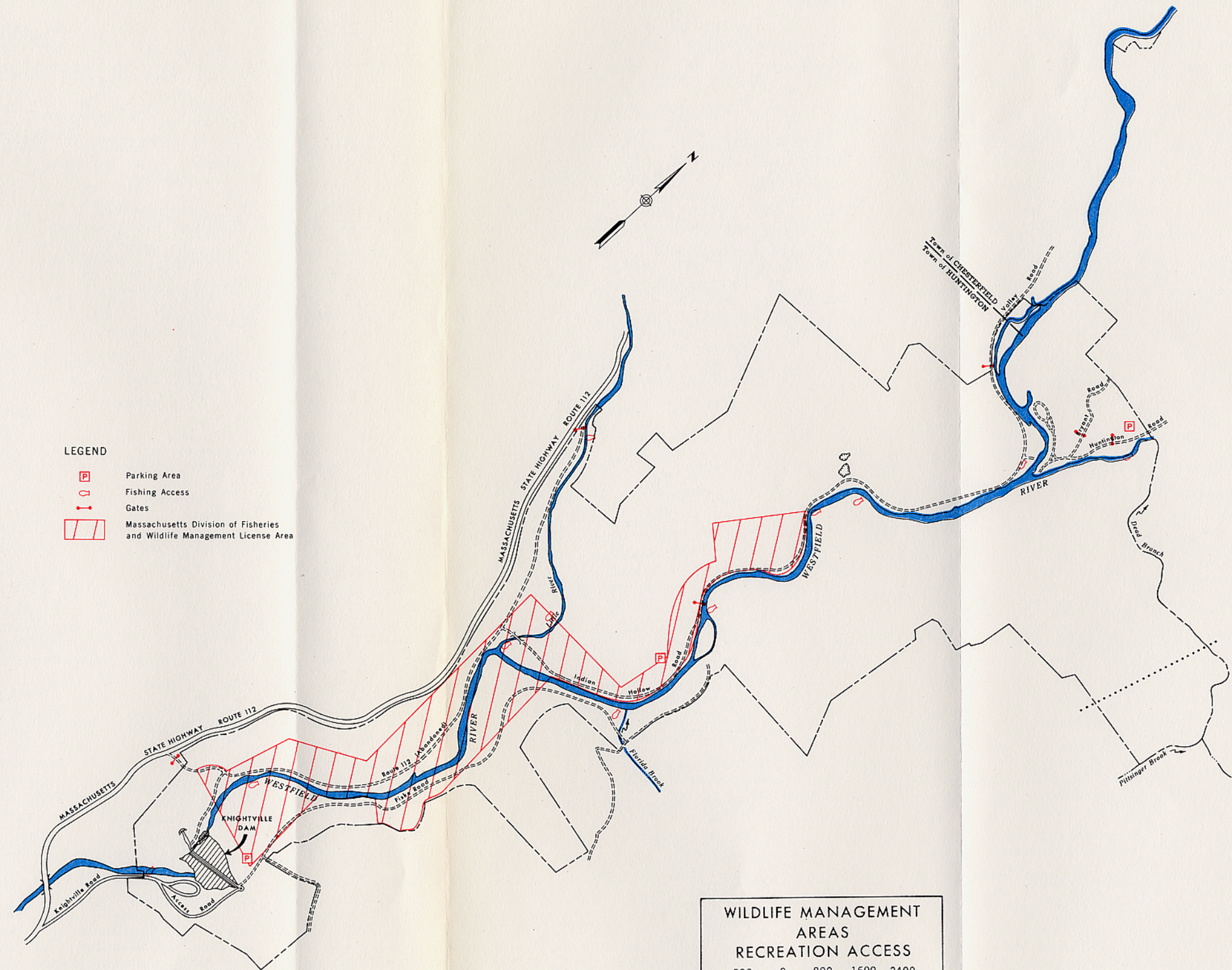


EXHIBIT B
MAP 2